

## **Technical, Economic and Environmental Analysis of a Wood Residues Based Cogeneration System in a Wood Industry in Amazon**

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The disposal of the high amount of wood residues produced by wood industries is indeed an environmental problem to be solved. On the other hand, when such industries are located in isolated regions, where the energy supply is not enough, there is the possibility of the use of these residues for electricity generation, supplying not only the wood industry but also selling the electricity surplus to the local grid.

In Brazilian Amazon, where most of the energy supply is from old and inefficient diesel generators, this proposal has the additional positive aspect of replacing high pollutant engines. According to recent evaluations from CENBIO [1], diesel consumption in Amazon to generate electricity was 980 million liters in 1997, corresponding to the emissions of 750 million tones of carbon, among other pollutant emissions (0.35 liters of diesel oil per kWh, 0.732 kg of C/liter of diesel oil).

This paper presents the technical, economic and environmental analysis of wood residues based cogeneration, in the study case realized by CENBIO and Winrock Foundation for a plywood industry in Amazon. The chosen industry has an international certification for wood products, with a production of 4,000 m<sup>3</sup> tones per month of plywood.

In the existing installation, the industry already utilize the process residues for energy generation (steam and electricity) but in a quite inefficient process where it is necessary to buy an additional amount of electricity from local utility, which is generated by diesel motors. The existing installation had two different boilers, one only for process steam generation and the other to produce steam to feed the turbo set.

Nowadays, this old equipment at the end of its lifetime need to be replaced and this is the adequate situation to introduce a more efficient cogeneration process. Also the industry is planning to expand its production process and there will be an additional availability of residues (from the current amount of 4,200 to the 8,400 t/month, after the expansion).

On the other hand, there are difficulties regarding the energy supply in the region and the local utility considered that the expansion on the energy supply would be based in diesel engines, as it happens today. Electricity consumption in the local municipality is growing strongly and the future supply appears to be a problem.

In this context this study was developed by CENBIO (funded by Winrock) to evaluate the potential of electricity generation possible to be generate from the wood residues available in the future. Also the economic analysis was performed, including the sensibility analysis when including existing subsidies for renewable energy in Amazon, as well as the incorporation of carbon credits, considering the opportunities of Kyoto Protocol.

For the evaluation of the availability of power supply, different configurations were analyzed, based on conventional steam systems (Rankine cycles), already commercialized in Brazil, as well as gasification systems still under tests. A gasification system was not included, because there is no commercialization of such systems for electricity generation and there are still problems to be solved regarding the gas cleaning allowing the gas to be fed into an engine. There are also strong problems related to operation and maintenance in Amazon, which are important barriers to the introduction of this technology in a short-term [2].

From the technical analysis, the economic analysis was performed and a 43 bar boiler/back pressure steam turbine was selected to be installed. The back pressure steam turbine was selected due to the high steam consumption in the industry compared to the availability of biomass. The installed power will be around 5 MW, 1MW for the industry consumption (after the expansion) and 4 MW to be sold to the grid.

The economic analysis was performed considering the incorporation of the existing subsidies for renewable energy in Amazon (around US\$ 100 per MWh generated from renewable energy, through the so called “Fuel Account – Conta Consumo de Combustíveis - CCC “). Because this is a significant figure when compared to the generation costs, the proposed cogeneration process becomes feasible even for a short period (8 years, 15% per year), adopted for the amortization of the investment. Also the internal rate of return is extremely interesting (from 50% to 56%), depending to the opportunity cost assumed to the biomass residue.

Also, the influence of such subsidy in the economic analysis is much higher than that from carbon credits, even considering the replacement of diesel oil and for carbon taxes up to US\$50 per tone of carbon. This result shows the enormous impact of CCC for the economic feasibility of biomass origin projects in Amazon. Considering the existing information from ANEEL (the National Agency of Electric Energy, the Brazilian regulatory agency) that this CCC will exist only until the year 2013, special policies are needed to extend it for a long period or to create new subsidies to replace it.

## References

- [1] “*Medidas Mitigadoras para a Redução de Emissões de Gases de Efeito Estufa na Geração Termelétrica*” (in Portuguese), “Mitigation Measures for the Reduction of Greenhouse Gases in Thermoelectric Generation in Brazil”, project developed by CENBIO – The National Reference Center on Biomass and funded by ANEEL – National Regulatory Agency on Electric Energy. Published by ANEEL, Brasília, 1999-2000, pp. 222.
- [2] “*Projeto de Referência para Utilização de Energias Renováveis na Amazônia*” (in Portuguese), “Reference Project for Renewable Energy Utilisation in Amazon”, project developed by CENBIO – The National Reference Center on Biomass and funded by ANEEL – National Regulatory Agency on Electric Energy, São Paulo, Brazil, 1999-2000.